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SECURITY INFORMATION

METHODS AND MATERIALS ON THE MEASUREMENT OF INDUSTRIAL PRODUCTIVITY

ORR 103-51

ANNEX "B"

This folder contains translations of abstracts from some of the principal published Soviet studies dealing with the subject of industrial productivity. This material was prepared for and used in connection with ORR project 103-51 but was not intended to be published as a part of that report and consequently is available only in the accompanying typewritten form.

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SOVIET SOURCES ON PRODUCTIVITY

Kukulevich & Rubin, Planirovaniye; Analiz Trudovyykh Pokazateley, 1948
(Methods of Calculating Labor Productivity) pp 139-141.

To calculate labor productivity in an enterprise, workshop, or section, one of the following methods is used:

1. Gross production method (based on the average production, in rubles, of an average worker).

In this method, the index of labor productivity is expressed as the ratio of the volume of the gross production output, in rubles, for the period concerned, and the average number of workers. In the case of local industry, production output is calculated in terms of unadjusted 1926-1927 prices.

For example, if production output in an enterprise for a given month amounts to 1.5 million rubles' worth, while the average number of workers was 300, the index of labor productivity is $\frac{1,500,000}{300} = 5,000$ rubles per worker.

2. Natural method.

The index of labor productivity is expressed as the ratio of the quantity of production for a given period in natural units (pieces, tons, meters, etc.) and the average number of workers.

For example, if production in a cast-iron foundry for a given period amounts to 150 tons of cast iron and the average number of workers is 75,

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the labor-productivity index is $\frac{150}{75} = 2$ tons per worker.

3. Labor method.

The index of labor productivity is expressed as the ratio between the time spent in production, in unadjusted units (man-days), and the average number of workers.

When production output is compared with a planned figure or with production for a previous (base) period, it is expressed in norm time units.

In such a calculation, it is advisable to use the norms used in drawing up the plan, as shown in the following table:

Type of goods	Quantity of goods produced for the quarter			Norm time in man-days	Norm days spent in production			Average number of workers		
	Base Period	Plan	Given Period		Base Period	Plan	Given Period	Base Period	Plan	Given Period
No. 1	2,500	3,000	3,000	3.0	7,500	9,000	9,000	--	--	--
No. 2	500	500	600	0.5	250	250	300	--	--	--
No. 3	3,500	4,000	4,500	1.2	4,200	4,800	5,400	--	--	--
	--	--	--	--	11,950	14,050	14,700	150	165	165
1	2	3	4	5	6	7	8	9	10	11

According to the table, the labor-productivity indices are:

- for the base period, $\frac{11,950}{150} = 79.6$ man-days.
- for the plan, $\frac{14,050}{165} = 84.1$ man-days
- for the given period, $\frac{14,700}{165} = 89.2$ man-days.

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The labor productivity of the given period compares with that of the base period as follows: $\frac{89.2 - 79.6}{79.6} \cdot 100 = 12.1\%$. It compares with the planned figure as follows: $\frac{89.2 - 84.1}{84.1} \cdot 100 = 6.1\%$

The gross-production method, in which the labor-productivity index is expressed in terms of value, is the basic method of expressing labor productivity in industry. The drawback to this method is that it does not properly reflect the dynamics of labor productivity in the case of a variety of products. These dynamics are most clearly reflected in the labor method. Therefore a calculation of labor productivity by the gross-production method should be complemented by a calculation according to the labor method. The natural method is used only for analysis of production of a single type of product.

If the calculation of labor productivity for an enterprise is arrived at solely by the gross-production method, adjustments must be made as follows:

- a. a shift in the assortment of goods produced.
- b. a change in the relative emphasis on the production of certain shops in the total volume of the enterprise's output.
- c. adjusting the quantity of unfinished goods.

(These factors are discussed at length).

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Ibid., pp 147-148

Basic Factors Affecting Labor Productivity

1. Mechanization, and better utilization of equipment.
2. Quality of materials, equipment, and apparatus.
3. Defects and breakage of semi-finished and finished products.
4. Absenteeism.
5. Length of the working day or week.
6. Demurrage.
7. Number of auxilliary workers.
8. Fullness of the working day.
9. Labor turnover.
10. Pay system.
11. Working conditions.
12. Training of workers.

(These factors are discussed in detail.)

Maslova, N. S., Proizvoditel'nost Truda, 1949, p. 80

Basic Factors in Increasing Labor Productivity in Soviet Industry

1. New techniques, mechanization of labor, automatic machines.
2. Improved standard of living for workers.
3. Increased training for workers.
4. Organization of production and labor.

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5. The Socialist principle of pay for labor.
 6. Socialist competition and the Stakhanovite movement.
- (The above chapter headings are followed by detailed discussion.)

Karl Marx, Zarabotnaya Plata, Tsena i Pribyl', 1948, pp 33-34: (Maslova p. 79)

1. Natural conditions of labor, e.g. fertility of soil, richness of a mine.
2. Progressive social factors, which result in mass production, concentration of capital, consolidation of labor, division of labor, machinery, improved production methods, use of chemical and other natural forces, shortening time and distance by means of communication and transport facilities and all the other inventions by means of which science compels the forces of nature to serve labor and thanks to which labor develops a social or cooperative character.

~~Ermakov, S. F. Organizatsiya Truda~~

Turetskiy, Proizvoditel'nost' Truda; Snizheniye Sebestoymost V Novoy Pyatiletke, 1947.

p. 51 Increasing labor productivity means reducing the expenditure of labor per unit of production. [Turetskiy's definition appears to be: "Labor productivity = expenditure of labor per unit of production."]

Ermakov, S. F. Organizatsiya Truda: Tekhnicheskoye Normirovaniye, 1948.

pp.5 ff. Labor productivity = production output per unit of time (e.g. hour, shift).

p. 6-7. In capitalist countries, labor productivity has a cyclical nature: in a period of rising economy, labor productivity increases, while during a slump it drops sharply...In the USSR, labor productivity has increased steadily from year to year, and there has not been a single period in the history of the country [sic] when labor productivity has fallen in comparison with that of the preceding year. The growth of labor productivity in the USSR follows the pattern of a law of constant validity.

p. 7-9. Labor productivity may be expressed not only in terms of

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quantity produced during a unit of time spent in production, but also in terms of time spent in producing a unit of production. Labor productivity may also be expressed in terms of an abstract quantity, i.e. by the index of fulfillment of the norm.

Production and expenditure of time vary inversely, since the greater the production in a unit of time, the less time is spent in production.

[Karl Marx, Kapital, I, p. 5 (Partizdat edition, 1936) lists factors affecting labor productivity.] [Lenin does likewise in Imminent Problems of the Soviet Government, Lenin and Stalin on Labor, Profizdat edition, 1941, p. 319]

Factors influencing labor productivity: degree or organization of production, [degree of] technological perfection, utilization of working time, and labor discipline. Also socialist competition. The major reasons for idleness of workers are: absence of assignments, repair of equipment, shortages of materials, care of tools, waiting for instructions from the supervisor, unauthorized resting, etc.

p. 10. The basic factors affecting labor productivity are:

A. Factors depending on general indices of the national economy:

1. natural resources of the country (coal, wood, petroleum, ore, rivers, etc.)
2. degree of development of production techniques for fuels, steel, cast iron, machine-building, the chemical industry, electric power, and materials for heavy industry.

B. Factors depending on the nature of technological processes:

1. Factors concerning the labor force
 - a. specialty, profession
 - b. skill, experience, record
 - c. labor discipline
 - d. concentration of labor in a given process
 - e. labor-consciousness (presence of Stakhanovites, shock workers, socialist competition, etc.)

2. Factors concerning the work

- a. hardness of metals
- b. type and quality of metals or other materials.
- c. accuracy and purity of processing
- d. type of load and tare (in loading and unloading jobs)
- e. weight of package, clearance of load

3. Factors concerning equipment

- a. type and make of machine
- b. capacity of machine
- c. technical condition of machine (physical wear)

4. Factors concerning organization

- a. readiness of working place at the beginning of the job
- b. condition of routes for transport
- c. illumination of working places
- d. use of working clothes
- e. pay system
- f. disposition of labor force and method of work
- g. efficient division of labor
- h. special conditions of work, such as deterioration of stored salt, uncomfortable work, cramped quarters, damage, temperature of the air, noise, etc.

Fundamental Organizational and Technical Measures to Increase Labor

Productivity [5-page table, drawn up for two kinds of shops in shipbuilding enterprises, for harbors, and for the fleet.]

Vladimirov, I. Proizvoditel'no Rabotat' vse 480 Minut, 1940.

p. 16. In 1937, the average output of coal per worker was 370 tons in the USSR, 311 in England, 435 in Germany, and 844 (as of 1929) in the US. In 1937 an average of 756 tons of iron was smelted per worker in the USSR, 548 in England, 505 in Germany, and 1,620 in the US. An average of 8,200 meters of cloth per worker in the cotton industry was produced in the USSR in 1937, as compared with 16,800 in the US in 1929.

On the whole, the productivity of units such as blast and open-hearth furnaces in the USSR has considerably exceeded that in the US and other countries. This is because the equipment in Soviet factories is superior and technically perfect, whereas in capitalist factories, obsolete equipment is replaced rather reluctantly.

In the USSR only one-fourth of all machine tools are over 10 years old, as compared with over 60 percent in the US. However, labor productivity per worker serving the unit averages lower in the USSR than in the US.

The big blast furnace at Magnitogorsk employs 150 persons, and the installations at Kuznets and Makeevka have 195 (each), while in the US furnaces of similar capacity employ only 93. Ninety-five persons work on the 150-ton open-hearth furnace at Kuznets, 100 each on the similar furnaces at Magnitogorsk and Makeevka, and 32 on comparable furnaces in the US. In the "Dzerzhinskiy" metallurgical plant, which produces 1.2 million tons of steel per year, over 20,000 blue-and white-collar workers were employed in 1939, while the Inland Steel Co. in the US, producing 1.5 tons of steel per year, had only 9,200 blue-and white-collar workers. Whereas 51 blue-and white-collar workers are employed in the South Amboy electric power station in the US, the Kemerovo power station, of similar capacity, employs 480. The US power station has only six administrative personnel: the chief engineer, chief electrician, laboratory engineer, technician, timekeeper, and secretary. There are 91 persons on the administrative staff of the Kemerovo station. The big Pittsburgh Coal Company mine has 15 administrative personnel, including the shift foreman. In the "Kizelugol'" (Ural) Trust's "Lenin" Mine, the administrative staff consists of 43 engineering and technical workers and 122 foremen, all of whom take no part in the technological process. While 49.6 percent of all the workers in the US mine are engaged directly in coal production, only 27.2 percent in the Soviet mine are so employed; and 11.3 percent of the workers in the US mine work above ground in the office, as compared with 30.1 percent in the Soviet, or 8 and 67 workers respectively. Yet the Pittsburgh mine produces 3 times as much coal.

the Ruhr, the US, and the Donbass [year not stated]:

<u>Category of Workers</u>	<u>Percent of total labor force</u>		
	<u>Donbass</u>	<u>Ruhr</u>	<u>US</u>
Stope workers	31.1	51.0	64.5
Others underground	41.6	26.9	20.3
Above ground	27.3	22.1	15.2

As shown in the table, for every stope worker in the mines, there are 2.22 other underground or above-ground workers in the Donbass, 0.96 in the Ruhr, and 0.55 in the US.

Productivity per stope worker in the Donbass mines is greater than in the Ruhr and only 21 percent behind that of the US. Productivity per worker in the Donbass represents only 62 percent of that in the Ruhr and 38 percent of that in the US.

According to data obtained in a survey of 81 mines in the Donbass 40-45 percent of all workers are auxiliary or white-collar. At least half of these (or 20 - 25 percent or more of all workers) work above ground (Ugol', No. 9, 1940, p. 46).

In 1938 Soviet coal production had been mechanized 90.1%. The mechanization of labor in the mines has radically changed working conditions. Nevertheless, some Soviet enterprises are still not operating so well as comparable enterprises in the best-developed capitalist countries.

Notkin, A. I. Proizvodstvennaya Programma Promyshlennosti, 1941.

p. 7. The average annual rate of increase in industrial production during the first 3 years of the third Five-Year Plan (1938-40) was 13%, while the planned rate for 1941 was 17-18% greater than in 1940.

Note that in each successive year, the absolute production increase for each percent of increase is actually much greater than it seems. Thus, in 1938, one percent of increase in industrial production meant 955 million rubles, while in 1941 it meant 1,375 million rubles (in 1926-27 prices).

p. 21. According to an announcement by the Gosplan published in Soviet newspapers of 15 January 1940, Soviet state industrial production in 1939 was 14.7% greater than in 1938, and defense production of the People's Commissariats was 46.5 percent greater.

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Changes in the Structure of Major Industrial Production in the USSR,
1913 - 1937 (in %) (Base year in parentheses):

Branch of Production	Gross production in 1926/27 prices					Average annual labor force				
	1928	1932	1937	1937	1937	1928	1932	1937	1937	1937
	(1913)	(1928)	(1913)	(1928)	(1932)	(1913)	(1928)	(1913)	(1928)	(1932)
Total major production	152.4	230.8	816.3	535.6	232.1	113.9	185.1	267.9	235.2	127.1
<u>Producers' goods</u>										
Metal-working	189.1	420.8	2,328.1	1,230.7	292.4	137.5	302.0	567.0	428.6	141.0
Metal-working in machine-building & repair shops	231.9	438.9	3,068.3	1,322.8	301.3	156.1	309.6	694.2	444.8	143.7
Electric power stations	402.2	376.2	4,606.6	1,145.3	304.4	161.8	201.5	589.7	864.4	180.9
Fuel extraction	145.4	190.4	501.9	345.1	181.2	101.8	178.7	195.0	191.5	107.2
Ferrous metallurgy	99.1	183.2	516.5	521.3	284.6	81.5	143.7	148.6	182.5	127.0
Nonferrous metallurgy	--	220.6	--	666.2	301.6	--	182.1	--	259.5	142.5
Chemical industry	142.7	328.5	1,576.0	1,104.1	336.0	171.5	239.7	597.5	348.4	145.4
Building materials	--	--	--	--	206.6	--	--	--	--	108.5
Cement building materials	98.5	198.5	275.3	279.4	140.7	102.2	153.8	174.4	170.7	111.0
Wood-processing	139.4	297.0	799.4	573.4	193.0	114.6	290.4	388.4	338.8	116.7
<u>Consumers' goods</u>										
Textile industry	140.7	139.0	356.7	253.4	182.3	101.1	115.55	147.8	146.1	126.5
Leather & fur industry	340.0	287.0	1,693.0	497.9	173.4	254.3	353.5	996.7	391.9	110.9
Food-processing industry	120.8	180.9	514.5	425.6	235.3	78.1	229.8	260.5	333.5	145.1
Paper industry	128.9	166.6	428.1	332.7	199.2	80.2	152.6	134.7	167.9	110.0

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Akademiya Nauk SSSR. Institut Ekonomiki. Ekonomika Sotsialisticheskoy Promyshlennosti, 1940.

p. 86. In 1937 the gross production of the machine-building and metal-working industries was 27.5 billion rubles, as compared with the planned 19.5 billion; or 2.9 instead of 2.1 times the 1932 figure. Electric power output rose from 13.5 billion kilowatt-hours in 1932 to 36.4 billion in 1937 (2.7 times); coal extraction from 64.3 to 128 million tons in the same period, pig iron from 6.2 to 14.5 million tons, steel ingots from 5.9 to 17.7 million tons, and rolled metal? from 4.3 to 13 million tons.

Production of rolled special steel? amounted to 2,508,000 tons in 1937, or 4.5 times the 1932 figure?; electric steel 860,000 tons, or 8.4 times; and 125,500 tons and 14 types of ferroalloys in 1936, as compared with 15,000 tons and 7 types in 1932. (A few more such figures are given.)

(Table, pp 106-107, gives 1937 production figures for 23 commodities. See also tables on pp 112 (gives 1942 figures), 114 (1938 and 1936), 116 (1937), 118 (1937), and ffg. 7

p. 459. During the first Five-Year Plan, production increased 37% because of greater labor productivity. During the second Five-Year Plan, it rose about 69% because of greater labor productivity, and only 31% of this increase was due to an increase in manpower. The third Five-Year Plan called for a further increase of 65% in labor productivity over the 1937 level, which should result in 62 billion rubles' worth of extra production (out of a total of 88.5 billion rubles' worth of planned extra production). An increase of 1% in average output during the third Five-Year Plan represents 950 million rubles' worth (in 1926/27 prices).

p. 460. Annual production per industrial worker in 1937 averaged 3.3 times the 1913 figure, while hourly production was 4.5 times that figure. During the first Five-Year Plan, annual production per worker in rubles (1926/27 prices) rose 41%, or an average of 7.1% per year. During the second Five-Year Plan, annual production per worker rose 82%, as compared with a planned 63%. During this period, labor productivity in heavy industry as a whole was 209.3% of the 1932 figure. The greatest increase occurred in ferrous metallurgy (the 1937 figure was 226.3% of the 1932 figure), followed by machine-building including defense orders

(211.2%). In the coal industry labor productivity was 165.4%, in the food industry 165.7%, and in light industry 135.9% of the 1932 level.

[Reference to productivity statistics in "World Production and Prices," 1937-38, published by the League of Nations.]

p. 462 ff. Reasons for Increased Labor Productivity [discussed in detail].

1. Systematic improvement in the material situation of the workers.
2. Socialist labor discipline.
3. Socialist competition and shock work.
4. Technical norms and organization of production.

p. 475. Methods for Calculating Labor Productivity:

Industrial labor productivity is planned and reported in terms of output per worker (for a year, quarter, or month) in rubles in unadjusted 1926/27 prices. This is the "gross-production" method. This method is now considered fundamental and compulsory for planning and calculating labor productivity for an enterprise as a whole, for a branch of industry, etc. This method lends itself to:

- 1) comparison of average output per worker from year to year
- 2) comparative study of a task in terms of volume of production and labor productivity
- 3) calculating the average productivity for a group of enterprises, for different branches of industry, or for industry as a whole
- 4) expressing the results of all work in the enterprise in terms of increased labor productivity.

A defect of this method is that, in using 1926/27 prices, we assume that the relation of prices to specific goods in 1926/27 more or less accurately represents the same relation today. Many kinds of products now being made were not made at all in 1926/27.

Also, when the gross-production method is used, output per worker will be substantially lower in branches of industry which produce raw materials (e.g., lumbering, coal-mining) than in those branches which process raw materials and semi-finished goods.

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prices): lumbering 1,700 rubles' worth, coal 2,344, ferrous metallurgy 7,220, cotton industry 7,540, leather industry 11,870, food industry 13,180 rubles' worth.

Clearly it is impossible to draw a direct comparison of output in different branches on the basis of these figures. It is not permissible to infer that labor productivity was highest in the food industry.

However, if average output from year to year is calculated for a given branch of the economy, there will be sufficient evidence to indicate the dynamics of labor costs by means of the dynamics of the average output.

Defects of the gross-production method are reflected in sharp changes in the relative emphasis on the production of certain branches, or by significant changes in assortment within a branch. In such cases the dynamics of output, expressed in prices, differs from the dynamics of labor productivity, which is expressed in terms of expenditure of labor. In the case of rapidly increasing production of a branch (or of a commodity within the branch) for which prices are high, calculation by the gross-production method shows exaggerated productivity. On the other hand, in the case of a rapid increase in the production of a branch or commodity subject to low prices in 1926/27, the gross-production method indicates decreased productivity.

The broader the basis for calculating average output (e.g. the average for an industry, kray, or oblast), the less will it reflect changes in assortment and volume of production of more or less costly products, and the more accurate will be the average and its dynamics. However, in a calculation of average productivity in 1926/27 prices for a single enterprise or a small group of products, the dynamics of the average output may not be significant.

Suppose an enterprise produces two kinds of shoes, leather and canvas. The same length of time, 4 hours, is required for each, but a pair of leather shoes is priced at 40 rubles, canvas at 25. Suppose that during a given period, 100 workers produce 400 pairs of leather shoes @ 40 rubles, totaling 16,000 rubles, and 400 pairs of canvas shoes @ 25 rubles, totaling 10,000 rubles. Altogether 100 workers produced 26,000

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In the next period the same number of workers produced 600 pairs of leather shoes @ 40 rubles, totaling 24,000 rubles, and 200 pairs of canvas shoes @ 25 rubles, totaling 5,000 rubles. Thus the same workers, working the same number of hours, produced 29,000 rubles' worth, or 2,900 rubles' worth per worker. The price [i.e. gross-production] method shows an increase in productivity, while the number of man- hours worked per unit of output remained unchanged. This example illustrates the fallacy of calculating labor productivity by the gross-production method for a single enterprise.

These defects of the gross-production method can be corrected by use of the index method and, where possible, by the method of expressing output in terms of actual measurements or in terms of labor costs.

Calculation of productivity by the index method eliminates the effect of changes in the volume of groups of products differing in price. The average rate of increase of productivity in an enterprise, etc. will depend solely on the number of workers in each shop or enterprise and on the increase in labor productivity achieved in each group of workers. The result thus computed reflects the average difference in labor costs. The index method is of an auxiliary nature, a check on the gross-production method. An example follows (p. 477):

<u>Enterprise or Branch</u>		<u>Report Period</u>	<u>Plan Period</u>	<u>Plan Period: Report Period (in %)</u>
A	Gross production (rubles)	500,000	600,000	120
	Number of workers	100	110	110
	Output per worker (rubles)	5,000	5,454	109
B	Gross production	500,000	750,000	150
	Number of workers	200	220	110
	Output per worker	2,500	3,409	136
Average by gross-product. method	Gross production	1,000,000	1,350,000	135
	Number of workers	300	330	110
	Output of worker	3,333	4,090	123

According to this table, the increase of labor productivity in the two enterprises A and B, calculated by the price [i.e. gross-production] method is 23%.

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The same calculation by the index method, using the number of workers of the plan period, shows an increase in productivity of 27%.

<u>Enterprise</u>	<u>Workers</u>		<u>Labor-Productivity Index</u>		
A	110	x	109	=	11,990
B	<u>220</u>	x	136	=	<u>29,920</u>
Total	330				41,910

41,910 ÷ 330 = 127%, the labor-productivity index according to the index method.

Another advantage of the index method is that it can be used with any form of expressing production: in terms of 1926/27 prices, natural units, current prices, etc. Of course, when the volume of production is given in current prices, production of both the base and the plan period must be estimated in equated prices of one and the same year.

Planning and calculating average labor productivity in terms of natural units (man-hours or man-days per unit of production) are limited by the vast diversity of industrial production. We use this method only for enterprises and branches of industry, the products of which are homogeneous and comparable. This method should be used, where possible, in connection with the gross-production (in terms of 1926/27 prices) method. Calculation in terms of natural units clearly reflects actual changes in expenditure of labor per unit of production (tons of coal, petroleum, iron, thousands of bricks, etc.), and corresponds closely with the methods of factory planning. It can be used in such single-product branches of industry as the coal, petroleum, and peat industries, ferrous metallurgy, iron mining, nonferrous metallurgy, the cement and brick industry, lumbering, the plywood and veneer industry, the match and cellulose industry, various food-processing industries, etc.

Labor productivity may be calculated in units of working time in branches of industry where technical norms are well established and where production conditions permit an accurate computation of working time in terms of production units, to complement calculation by the gross-production method.

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The following table shows a calculation of labor productivity in units of working time (p. 478):

Product	Period	Quantity	Price Ea. (rubles) (1926/27)	Total Value	Norm Hours Per Product	Total Hours
A	Report	1,000	5.--	5,000	0.5	500
	Plan	1,000	5.--	5,000	0.5	500
B	Report	2,000	1.50	3,000	1.0	2,000
	Plan	3,000	1.50	4,500	1.0	3,000
C	Report	3,000	3.--	9,000	1.2	3,600
	Plan	3,300	3.--	9,900	1.2	3,960
A,B & C	Report	--	--	17,000	--	6,100
	Plan	--	--	19,400	--	7,460
Plan + report (in %)		--	--	114.1	--	122.3

In order to meet the plan without increasing the number of workers, labor productivity must be increased not by 14.1 percent, which is the amount of increase in gross production, but by 22.3, to correspond with the increase in norm time.

This method does not allow for certain important factors:

1. Norm fulfillment is not uniform in all sections and for all workers, and actual expenditure of time in production will not be the same as norm time. Even the calculation of norm fulfillment is highly inaccurate in most enterprises.
2. Such a calculation does not include the auxiliary shops and occasional workers.
3. Calculation in terms of norms is even less convincing in the cases of changes in the structure of production (new products, changes in type of production). The norms differ considerably in definition and in the degree of their fulfillment. In the absence of a practical test, the preliminary definition of norms for new or changed products is highly subjective. In the case of significant changes in production structure, calculations on the basis of norms are very inaccurate and tend to err in the direction of minimizing possible productivity.

Because of its many shortcomings, the labor-cost method should be used only for branches of industry which have a high level of labor accounting and norms, such as the machine-building industry, since this method can be used only where work and production are comparable. The basis of the calculation must be not norm time but actual time spent in producing the given product. Under such conditions the computation of expenditure of labor in hours per unit of production can be of value in drawing up a plan for increased labor productivity.

Kuz'minov, I. Stakhanovskoe Dvizheniye, 1940

p. 183. Dynamics of the Average Annual Output Per Worker in Soviet Industry (in % of figure for the preceding year):

1930, 109.7; 1931, 107.6; 1932, 102.6; 1933, 108.7; 1934, 110.7; 1935, 113.0; 1936, 121.4; 1937, 108.9; 1938, 111.0.

(Figures for 1923 through 1929 also are given.)

p.184. Between 1928 and 1936 the annual increase in the output of Soviet industry averaged 11 percent.

p. 185. The following table shows the increase in labor productivity in the coal industry in the USSR and capitalist countries in Europe, in tons:

<u>Coal Mined Per Year Per Worker (tons)</u>							
<u>Country</u>	<u>1913</u>	<u>1929</u>	<u>1933</u>	<u>1934</u>	<u>1935</u>	<u>1936</u>	<u>1937</u>
USSR	149	174	189	224	257	306	315
England	264	275	272	287	299	309	314
France	203*	184	196	212	215	210	195
Belgium	156	177	188	210	216	230	238

* prewar boundaries

<u>Iron Smelted per Worker (in tons per year)</u>								
<u>Country</u>	<u>1913</u>	<u>1929</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>	<u>1935</u>	<u>1936</u>	<u>1937</u>
USSR	205	-	240	265	370	486	640	756
Germany	400	612	474	461	530	590	543	-
England	356	366	326	410	455	484	530	513
Belgium	470	525	(-----not known-----)					

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Between 1934 and 1937 the output of steel per worker in Soviet plants rose from 190 to 460 tons, as compared with 406 tons in Germany in 1937. In the machine-building industry in 1936, Soviet foundries produced 23 tons of assorted castings per worker, as compared with 21.1 tons in Germany. In 1937 the output of all [sic] Soviet metallurgy per worker in ferrous [sic] metallurgy was 137 tons. (The index of output of all metallurgy per worker in ferrous metallurgy is not accurate in view of the differences in basic products in different countries. For example, iron and steel differ in proportion of alloy metals, rolling, etc. However, the index gives an over-all picture of the branch.)

In 1937 the Glavstankoproma Factory produced 0.64 machine tools per worker. [More information may be available in Berri's "Sovetskoye v Nazhale Tret'ey Pyatiletki" (Soviet Machine-Tool Construction at the Beginning of the Third Five-Year Plan) in "Planovoye Khozyaystvo" (Planned Economy), No. 9, 1938, p. 527]

Annual production per worker in the Soviet cotton industry was 6,258 square meters of cloth in 1936 and 8,200 in 1937.

The number of workers per blast furnace in the new Soviet metallurgical works is given in the following table (p. 190):

	<u>1936</u>	<u>1937</u>	<u>1938</u>
Magnitogorsk	252	186	157
Kuznets	252	204	200
Makeevka	216	189	166

In 1937 the open-hearth furnace at Magnitogorsk was served by 167 workers, and that at Kuznets by 133, while in the US similar furnaces were served by only 40-45 workers.

[Contrast undated pre-1940 figures in Vladimoror, I. op. cit. above.]

The average number of personnel employed in Soviet steam power stations per thousand kilowatts is 6 times that in comparable US stations. The same is true in machine-building and other branches of industry. Thus, in 1936, 1,695 blue-and white-collar workers were employed in the "Kalinin" Machine-Building Factory of the Gormash Trust, while the Byron-Jackson Machine-Building Factory in the US, of similar capacity, employed only 622.

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The Soviet metallurgical plants, including their industrial transportation, about two-thirds of all the blue-and white-collar workers are employed in auxiliary shops, and sometimes more. About half the total personnel in machine-building work on auxiliary jobs.

One reason for the disproportionate number of auxiliary workers is the decentralization and unsatisfactory organization of repair. Although all metallurgical plants have huge mechanical, casting, forging, and other shops equipped for all auxiliary jobs in the entire plant, in almost all the plants the basic shops are provided with their own subordinate organization. For example, the blast furnace of the Magnitogorsk enterprise has its own machine shop with a staff of 145, an electric-machine shop with 51, and a repair shop with 75. These total 271, or about half of all the blast-furnace workers. The same situation prevails throughout the combine, although it is equipped with a high-capacity shop for the plant as a whole.

p. 192. A similar situation exists in the coal industry. In 1937 about 25,000 workers were employed in the Donbass in electric-machine shops alone (both underground and surface). There was one repair worker in the Donbass in 1937 for every 300 tons of coal mined, as compared with one per 40,000 tons in the "Nemakolin" [not identified] mine in the US. One reason for the excess of repair workers is the primitive organization of all repair work. Many machines and tools which should and could be mass-produced in special factories or workshops, are made in primitive fashion in shops in the mines.

p. 193. Although the USSR leads the world in the mechanization of coal mining, certain aspects were inadequately mechanized in 1937: surface mining only 67.3 percent, transport 47.6 percent, and such processes as loading, timbering, repairing timbers, and removal of rock were scarcely mechanized at all. [More figures on mechanization, pp 194-5]

p. 196. Average annual pay has increased from 1,858 rubles in 1934 to 3,467 rubles in 1938, or 86.5%.

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Begidzhanov, M. Tekhnicheskoye Normirovaniye i Vnedreniye Progressivnykh Norm, Moscow, 1950.

p. 8. During the first two Staline Five-Year Plans, labor productivity in the USSR rose 103 percent, During the second Five-Year Plan, about 148-50 billion rubles were saved by increased labor productivity and more effective utilization of means of production. Of this sum, 56% was spent to increase average wages. During the third Five-Year Plan, 70% of the total savings was spent to increase wages.

Between 1942 and 1944, labor productivity in industry as a whole increased 40%. The postwar Five-Year Plan calls for an increase in labor productivity of 36% as compared with the prewar level.

[pp 15-19 define the following terms: production process, technological process, operations, productive and unproductive work, norm time (broken down into five constituent types of time), operational time, demurrage. pp. 25-29 define various methods of establishing norms. pp 29-39 discuss utilization of equipment and materials.]

pp. 31-32. In 1938, as a result of mechanization, capital repairs and renovation, modernization of equipment, new techniques, improved organization of production, and socialist competition, many metallurgical enterprises made a better showing than in 1940. For example, the coefficient of utilization of the capacity of the blast furnaces at Magnitogorsk was 0.91, and at the "Petrovskiy" Plant 0.98. At the "Azovstal'" (Azov Steel) Mill 6.1 tons of steel were drawn off per square meter of hearth in the open-hearth furnaces, 6.09 tons at Kuznets, and 5.9 tons at Magnitogorsk.

In 1949 the Magnitogorsk metallurgical plant reached the level of production planned for 1950, while the Magnitogorsk Combine fulfilled its Five-Year Plan for volume of production of ore, coke, and rolled metal in 3 years.

The Kuznets Metallurgical Plant fulfilled its Five-Year Plan for the production of steel and rolled metal in 3 years, and its plan for smelting iron in 3 1/2 years. The average daily output of steel ingots and rolled products in [the first 9 months of 1949 was 10% above the figure planned for 1950, solely because of better utilization of existing equipment, as no new units were put into operation.

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Demchenko M. Puti Pobysleniya Proizvoditel'nosti Truda v Sotsialisticheskoy Promyshlennosti. Moscow, 1950.

p. 6. In the coal-mining industry, output per worker employed in the industry in 1937 was 327 tons in the USSR, as compared with 311 in England and 195 in France. The same year, 756 tons of iron were smelted per worker in the USSR, as compared with 612 tons in Germany and 530 in England. /ct. p. 9 and 25 of this digest/.

In 1937, the "Stalin" plant in Magnitogorsk smelted 2,140 tons of iron per worker.

Annual output per worker in the USSR in 1937 was 3.3 times the 1913 figure, and hourly output was 4.5 times the 1913 figure.

During the first Five-Year Plan, labor productivity rose 41% and during the second, 82%. The third Five-Year Plan calls for further increases in labor productivity of 65% in industry, 75% in construction, 32% in rail transport, and 38% in water transport.

Of the total increase in production during the third Five-Year Plan, or 88.5 billion rubles, 70 percent of that sum, or 62 billion, is accounted for by increased labor productivity. Only the remaining 30% of the increase in production is explained by an increase in personnel.

The law on the Five-Year Plan for 1946-1950 calls for "increasing labor productivity through full utilization of the 8-hour working day, universal mechanization....., further electrification of the economy, and intensification /sic/ of production processes."

Labor productivity in 1950 is scheduled to exceed the prewar level by 36% in industry and by 40% in construction. Of the total increase in industrial production in 1950 as compared with 1940 of 66.5 billion rubles, three-fourths is to be achieved through increased labor productivity, and only one-fourth through increased personnel.

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In 1947, labor productivity was 13% above the 1946 level; in 1948 it was another 15% above the prewar level; and in 1949 it was 13% above the 1948 figure. Of the rise in 1949, 15% was accounted for by machine building, 14% by metallurgy, and 12% by the coal industry.

The campaign for a rapid increase in labor productivity embraces all Soviet industry, all branches of production. Many plants are greatly exceeding their quotas. In the "Manometr" Factory, which completed its Five-Year Plan for volume of production in 1949, labor productivity in 1949 was almost 3 times the 1946 figure, and production output was over 3.5 times the 1946 figure. In the "Kalibr" Factory, labor productivity in 1949 was 2.3 times the prewar figure. In the Karbyurator Factory it was 2.7 times the 1946 figure.

In the "Stalin" Automobile Factory in Moscow, labor productivity in 1949 was 14% above the 1948 figure and 36% above that of 1940.

p. 13. Mechanization of coal mining increased from 16.5% in 1928 to 29.6% in 1937. In ferrous metallurgy the smelting of iron in fully mechanized blast furnaces in comparison with all smelting, was 7.2 percent in 1930, 60% in 1937, and 80% in 1940. The wood industry's tractor park increased 7 $\frac{1}{2}$ -fold, its motor vehicle park 15-fold, and its locomotive park 3-fold between 1935 and 1941. Before the war, transport of timber was 36% mechanized.

Between 1928 and 1937 the degree of technical equipment (i.e. value of basic production facilities as compared with number of workers) in Soviet industry developed as follows: the coefficient of power equipment (i.e. capacity of motors as compared with number of workers) increased from 2,460 kilowatt-hours per worker to 5,700, or 2.3-fold; and the coefficient of electrical equipment (i.e. capacity of electrical installations as compared with number of workers) increased from 1,310 kilowatt-hours per worker to 4.3 kilowatt-hours, or 3.3 fold. In 1950, the coefficient of technical equipment in industry increased 1.5 times over 1940.

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The complicated machinery installed by the coal industry after the war included equipment not only for the actual extraction of the coal, but also for transporting and loading and for preparatory work.

Throughout the coal industry, mechanization of coal mines now exceeds the prewar level. In cutting it has reached almost 100%, in loading coal into railroad cars about 97%, and in transport 84%.

A detailed discussion of mechanization in the coal industry appears on pp. 14-15.⁷

In the construction industry, the number of excavators has increased 63% since 1946, stone-crushers 64%, concrete mixers 57%, and cement mixers 62%.

In 1948, earth work was 60% mechanized, and 4.7 times as much work was done by machinery as was done by machinery in 1940. One excavator with a shovel capacity of 1 cubic meter does the work of 300-350 workers. It costs about 3.26 rubles to prepare 1 cubic meter of concrete by hand, and only 0.86 rubles by machine.

Similar discussion of mechanization in the lumber industry, pp. 15-16, and other industries, pp. 16-17.⁷

The Five-Year Plan calls for doubling the Soviet machine inventory as compared with 1940, as well as 3.7 times as much metallurgical machinery, 2.5 times as much electrical equipment I. e. equipment used in power production⁷ and 4 times as much textile machinery. By the end of the Five-Year Plan, there are to be 1,300,000 metal-working machine tools, or 30% more than the U. S. had in 1940. Most of these, of course, will be new, improved machines of high productivity.

p. 24. To increase productivity:

1. Eliminate the "shturm" (which means rushing to make up for lost time after letting production lag during the first two-thirds of the month.

2. Keep a graph of output by the day and by the shift; if possible, also by the hour.

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3. Improve labor organization; especially by proper assignment of workers, eliminating irresponsibility, and making full use of the working day.

4. Properly organize technical norms and wages.
5. Improve living conditions and training of workers.
6. Strengthen socialist discipline of labor.
7. Organize socialist competition.

The above methods are discussed in detail.

p. 43. Labor productivity is expressed in terms of the amount of output produced by a single worker in a unit of time. The labor-productivity index is the ratio of the volume of output and the working time spent in producing it. If P = labor productivity, V = volume of output, and T = working time spent in production, $P = \frac{V}{T}$.

The greater the volume of output and the less the working time, the greater the labor productivity. Labor productivity can be increased either by increasing the volume of output or by shortening the time spent in production.

Labor cost (i.e. working time spent in production) can be expressed in three ways: as norm time, actual time, or planned time. These are defined on p. 44.

Output per worker is usually expressed by dividing gross production (expressed in natural units, norm hours, or in value) by the number of workers. If gross production in an enterprise for a given month is worth 32 million rubles, and 8,000 persons are employed, output per worker for the month = $\frac{32,000,000}{8,000} = 4,000$ rubles' worth.

Methods of computing hourly, daily, monthly, quarterly, and yearly production are given on pp. 47-48.

Labor productivity can be increased by the following methods: decreasing labor costs as defined above, lengthening the working day or week, eliminating unauthorized absences and sickness, etc.

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Tsentral'nye Statisticheskoye Upravleniye Gosplana SSSR, Otdel Uchebnykh Zavedeniy. Slovar' - Spravochnik po Sotsial'no - Ekonomicheskoy Statistike. Moscow, 1948.

p. 80. Index of Physical Volume of Production: ...In the USSR heterogeneous products of different periods are compared by the use of an index of physical volume of industrial production based on constant prices for all products of state industry, calculated in 1926/27 prices. For cooperative industry, 1932 prices are used.....

Turetskiy, Sh. Proizvoditel'nost' Truda i Snizheniye Sebestoimosti v Novoy Pyatiletke. Moscow, 1947.

pp 8-9. Between 1927 and 1932 the [production ?] cost of petroleum fell 38%, while petroleum workers' pay rose 60%. The production cost in ferrous metallurgy fell between 1932 and 1937 by 20.7%, while the workers' pay increased 105.8%. During 1933 - 37, as compared with 1932, 48-50 billion rubles were saved as a result of increased efficiency of production in public enterprise and because of improved utilization of production facilities in socialist industry. About 28 billion rubles of this sum was used to increase the average wage, about 9 billion was spent to encourage the production of industrial crops and other farm products, and the remainder was spent in capital investment.

The third Five-Year Plan allocates 70% of the total saving to increasing the average wage and 30% to capital investment.

p. 10. At the end of the second Five-Year Plan, over 80% of all industrial production was produced in new or completely rebuilt plants. Half of the machine tools during the second Five-Year Plan were new, and the amount of electrical equipment used in industry more than doubled. [A list of technical developments, in general terms, follows.] About two thirds of the entire increase in industrial production during this period is attributable to increased labor productivity.

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p. 49. After the civil war the average annual increase in industrial labor productivity was 25%. In 1929 industrial labor productivity was 40% greater than in 1926; during the first Five-Year Plan it increased 41%; and during the second Five-Year Plan, because of new techniques and the Stakhanov movement; it increased 82%. Between 1938 and 1940 it increased 32%, which represents an average annual increase of 10%, as compared with the 10.5% called for by the Plan for 1937-42.

p. 56. During the war, labor productivity in the Urals? in surface coal-mining was 4 times that in the pits, and costs in the former were only half. The new Five-Year Plan calls for an increase in surface coal-mining from 6.3 million tons in 1940 to 27 million in 1950. The increase in the proportion of surface mining means that 45,000 fewer coal miners will be required per year.

p. 57. If the planned amount of non-ferrous metals is to be smelted in 1950, 180 million tons of ore must be mined.

p. 61. A national labor reserve of $4\frac{1}{2}$ million qualified workers, or almost twice the figure for 1940-45, is to be trained for the period 1946-50. During this period, 7.7 million new workers are to be trained and the skill of 13.9 million others is to be increased by means of training and courses for brigades and individuals.

Gurink, L. E. Voprosy Organizatsiy Zarabotnoy Platy na Mashinostroytel'nykh Predpriyatiyakh, 1950.

p. 15. The average number of blue - and white-collar workers employed in the USSR in 1929 was 12.2 million; in 1933, 22.3 million; in 1937, 27.0 million; in 1940, 30.4 million; in 1950 (planned figure), 33.5 million.

Increase in Pay of Blue- and White-Collar Workers in the
Entire Soviet Economy

	<u>1932</u>	<u>1937</u>	<u>1940</u>	<u>1950 (plan)</u>
Average annual pay (in rubles)	1,427	3,047	4,054	6,000
Workers' wage fund (in billion rubles)	32.7	82.2	162.0	252.3

An additional 40% should be added to the above figures of
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contributions for the social and cultural benefit of workers and to improve workers' living conditions. In 1940 these supplementary allowances amounted to 40.7 billion rubles, and in 1950 are slated to reach 106 billion. Actual expenditures for this purpose in 1949 exceeded the planned figure and reached 110 billion rubles.

Tsentral'noe Upravleniye Narodno-Khozyaystvennogo Ucheta Gosplana SSSR. Trud v SSSR (1934 god.) Moscow, 1935. /Volume for 1935 available in Library of Congress, but cannot circulate./ English edition, published in Moscow, 1936, available in ORR Library, contains extensive and detailed statistical data on Soviet Economy.

Maslova, N.S. Proizvoditel'nost' Truda v Promyshlennosti SSSR. Moscow, 1949. /This book is abstracted at some length below./

p. 27

Annual Russian Factory Production
In 1926/27 prices

	<u>1913</u>	<u>1921</u>	<u>1922</u>	<u>1923</u>	<u>1924</u>	<u>1925</u>	<u>1926</u>	<u>1927</u>
Industrial production (in million rubles)	10,251	2,004	2,619	4,005	4,660	7,739	10,704	12,264
Rate of production increase (in % of preceding year) --		142.1	130.7	152.9	116.4	166.1	138.3	114.6
Annual output per worker (in rubles)	3,955	1,544	2,184	2,707	2,744	3,652	4,314	4,626
Average annual output per worker (1913 = 100)	100	39.0	55.2	68.4	69.4	92.3	109.1	117.0

p. 34. In 1935, 50.4% of all workers and 68.8% of the capacity of all power machinery in the USSR were concentrated in enterprises employing over 1,000 workers. Concentration was especially great in Soviet ferrous metallurgy. On 1 January 1928 there were no blast furnaces in the USSR with a capacity of over 900 cubic meters, while on 1 January 1937, 40.7% of the total capacity of Soviet blast furnaces belonged to installations of such size.

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p. 35. The gross production of all Soviet industrial production, expressed in unadjusted prices, was as follows (in billions of rubles): 16.2 in 1913, 21.4 in 1928, 43.3 in 1932, 95.5 in 1937, and 138.5 in 1940.

The gross production of Soviet industry in 1940 was almost 9 times the 1913 figure, while that of large-scale industry had increased 12 fold. However, production in the extractive branches of industry increased rather slowly: in comparison with 1913, iron production in 1940 was almost 4 times greater, steel 4.5 times, coal 5.5 times, and petroleum 3.5 times. In 1913 industry's share in the gross production of the national economy was 42.1%, in 1932 was 70.7%, and in 1937 was 77.4%. The production of capital goods progressed from 33.3% of all industrial production in 1913 to 53.6% in 1933, 57.8% in 1937, and 61% in 1940. The machine-building industry alone accounted for 6.8% of all industrial production in 1913, 19.6% in 1932, 25.5% in 1937, and 31% in 1940.

p. 38. During the second Five-Year Plan, the total increase in Soviet industrial production amounted to 51 billion rubles (in 1926/27 prices). Of this sum, 30.5 billion was accounted for by increased labor productivity.

p. 39. Labor productivity increased during the first Five-Year Plan despite the transition from an 8-hour to a 7-hour day, as follows:

<u>Branch of Industry</u>	<u>Output per Worker, 1932</u> <u>(1928 = 100)</u>
Group A	153.1
Fuel	144.7
Coal	124.0
Petroleum (extraction)	179.9
Ferrous metallurgy	134.5
Nonferrous metallurgy	123.6
Machine-building	163.8
Basic chemical	136.9
Consumers' goods	
Group B	140.8
Cotton	122.5

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<u>Branch of Industry</u>	<u>Output per Worker, 1932</u> <u>(1928 = 100)</u>
Consumers' goods (continued)	
Silk	134.2
Hemp, Jute	163.0
Knitting	153.0
Leather, Shoes	127.4
Printing	169.4
Food	149.5
Tobacco	184.2
Sweets	291.3

In 1929 alone industrial labor productivity increased 13% in comparison with the preceding year. During the second Five-Year Plan it increased even faster than during the second, averaging 14.9 percent per year. This steady increase was made possible by the adoption of new techniques.

Industrial labor productivity increased during the second Five-Year Plan by 82% instead of the planned 63%. In heavy industry the increase was 109.3%, as compared with a planned 75%. The following table shows the index of industrial labor productivity during the second Five-Year Plan:

<u>Branch of Industry</u>	<u>Output per Worker, 1937</u> <u>(1932 = 100)</u>
Heavy industry	209.3
Machine-Building	211.2
Ferrous metallurgy	226.3
Coal	165.4
Light Industry Narkom*	135.9
Cotton	142.5
Wool	151.3
Leather, Shoes	124.4
Wood Narkom (factory processing)	160.2
Food Narkom	165.7

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p. 41. The following table compares industrial labor productivity in the USSR and in capitalist countries:

<u>Country</u>	<u>Output per worker</u> <u>(1929 = 100)</u>	
	<u>1933</u>	<u>1937</u>
USSR	120	203
Capitalist world	96	104
US	93	97
England	93	110
France	97	92
Germany	92	110
Italy	93	95

p. 42. Annual output per worker [in the USSR?] increased as follows in the years from 1928 to 1939 inclusive (in % of the preceding year): in large-scale industry, including heavy industry: 112.2; 112.9; 109.7; 107.6; 102.6; 108.7; 110.7; 113.0; 121.4; 108.9; 111.0; 116.7; in heavy industry alone, 111.1; 116.4; 113.2; 105.7; 106.7; 110.4; 115.6; 117.9; 124.5; 106.7; 112.4; 114.5.

The increase in labor productivity during the second Five-Year Plan reflects the successful adoption of new techniques and the rise of the Stakhanov movement.

The most rapid increase in labor productivity occurred in the machine-building industry. During the first Five-Year Plan the increase was 63.8%, and 111.2% during the second. During this period labor productivity in the machine-building industry in the US scarcely rose at all.

p. 44. The following table shows the decrease in the number of man-hours per lathe expended in the "Krasnyy Proletariy" Factory:

	<u>1913</u>	<u>1924</u>	<u>1927</u>	<u>1932</u>	<u>1937</u>	<u>: Index 1937</u> <u>:(1913 = 100)</u>
Man-hours per lat lathe	3,330	1,925	907	492	393	847

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In the tractor industry, which was founded during the first Five-Year Plan, 1,023 man-hours were required to build an "STZ" tractor in 1930, 329 in 1932, and 105.5 in 1937. Between 1930 and 1937, the labor cost of building tractors was reduced to one ninth.

During the first Five-Year Plan, the increase in annual output per worker in ferrous metallurgy lagged behind the rate of heavy industry as a whole. During the second Plan, ferrous metallurgy showed a faster increase than machine-building. Ferrous metallurgy showed a rise in labor productivity from 34.5% under the first Plan to 126.3% under the second. The greatest annual increase in this branch occurred in 1936.

p. 45. The output per worker of pig iron from blast furnaces during the second Plan was as follows: 248 tons in 1932, 282 in 1933, 396 in 1934, 517 in 1935, 676 in 1936, and 756 in 1937. During the same period output per worker in open-hearth furnaces increased from 140 tons in 1932 to 400 in 1937. Thus labor productivity in ferrous metallurgy is seen to be greater if expressed in natural units than in unadjusted prices.

The increase in labor productivity in ferrous metallurgy during the second Plan is explained largely by the activation of new and fully mechanized furnaces, the rebuilding of old ones, more intensive use of productive capacity, improvement of labor organization (the number of workers per furnace was cut almost in half), and the development of the Stakhanov movement.

The technical reconstruction of the Soviet petroleum industry took place in the revolutionary period. This resulted in rapidly increased labor productivity during the first Plan. In Baku the number of man-days worked per meter of penetration decreased from 18.5 in 1924-25 to 4.7 in 1933 and 1.8 in 1936.

As most of the equipment of the textile industry during the first two Plans was old, improved utilization of equipment was particularly important

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in labor productivity. In the cotton industry, labor productivity rose 22.5% under the first Plan and 42.5% under the second. Output per worker expressed in natural units was less impressive. From 1927/28 to 1939, output per worker in spinning rose 31%, from 59.33 units per hour to 77.97, and in weaving it rose 55.5%. The greatest increase in annual output occurred in the knitting and silk industries, which were new branches of the textile industry and so had new equipment.

The complete renovation of the leather-and-shoe industry under the Five-Year Plans resulted in greatly increased production and labor productivity. During the first Plan annual output [per worker?] increased 27.4%, and during the second, 24.4%. Expressed in natural units, this labor productivity seems much higher; for shoes, 79% greater during the first two Plans. Labor productivity increased 64% in the "Skorokhod" Shoe Factory under the second Plan.

Increased labor productivity expressed in value does not accurately reflect changes in the use of labor. The deviation between productivity indices expressed in value and those in natural units is greater, the greater the change in assortment of products or of raw materials used. This is particularly evident in the case of the leather-and-shoe, food, and wool industries.

Hourly as well as annual output per worker in Soviet industry showed a steady increase under the Plans: 61.1% during the first and 118.7% during the second. Hourly output per branch of industry also increased faster than annual output. Hourly output per worker represents labor productivity expressed in a definite unit of time actually worked, and does not reflect the fullness of the entire working day, much less of the entire working year. Thus the annual output is a better indicator of the characteristics of the dynamics of productivity for all industry than hourly output is. However, the transition to a shorter working day means that annual output at the beginning of the first and at the end of the second Plan is calculated on the basis of different numbers of working

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hours, so that for this period hourly output more accurately represents the increase of labor productivity.

During the depression, annual output in capitalist countries was lower and hourly output increased. Between 1928 and 1937, hourly output in US industry increased 20.4%, while annual output dropped 2.2%. The great increase in hourly output resulted from excessive capitalist efficiency measures. In the USSR, on the other hand, both annual and hourly output rose because of the universal reduction of labor expenditure, resulting from new techniques and increased mechanization.

The greatest increase in labor productivity during the first two Plans occurred in new enterprises. In 1932, labor productivity in new enterprises was 14.2% greater than in old enterprises. In the machine-building industry, labor productivity in new enterprises was 55.8% greater, in the basic chemical industry 18.5% greater, and in ferrous metallurgy 18.6 greater. In the coal industry and some others, however, labor productivity was lower in new enterprises than in old, chiefly because the introduction of new techniques and equipment was rather slow.

The following table shows output per worker, expressed in value (rubles), in new machine-building plants during their first years of operation:

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Year	QUARTER				annual
	I	II	III	IV	
"Molotov" Plant in Gorki	1,036.0	1,176.0	1,537.0	2,059.0	6,071.0
1932					
1933	2,447.0	3,359.0	2,906.0	3,527.0	12,386.0
1933 index (1932 = 100)	236.2	285.6	189.1	171.3	204.0
"Kaganovich" State Bearing Factory	2,215.0	1,465.0	1,315.0	1,720.0	6,408.0
1932					
1933	2,612.0	2,730.0	3,064.0	3,312.0	11,967.0
1933 index (1932 = 100)	117.9	186.3	233.0	192.6	186.8
"Ordzhonikidze" Machine-Tools Factory	354.0	458.0	651.0	1,364.0	3,148.0
1932					
1933	1,126.0	1,504.0	1,727.0	2,720.0	7,430.0
1933 index (1932 = 100)	318.1	328.4	265.3	199.4	236.0
"Kalinin" Milling-Machine Factory ("Prezer")	--	911.0	1,041.0	1,202.0	3,290.0
1932					
1933	1,413.0	1,542.0	1,574.0	1,828.0	6,528.0
1933 index (1932 = 100)	--	169.3	151.2	152.1	198.4

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As shown in the above table, during their first year of operation, these four new plants fell below the level of labor productivity of the machine-building industry as a whole. The following year their labor productivity was approximately twice as great as during their first year. Of course, if an enterprise where new techniques are being introduced can take advantage of the experience of a factory which has previously used those techniques, labor productivity in the new factory during its initial period will be higher than if such experience were not available. For example, the Stalingrad tractor factory was built before the "Ordzhonikidze" Tractor Factory in Kharkov was begun. The experience of the Stalingrad factory was made fully available to the new one. In the latter's first year of operation (1932) it produced 8,196 rubles' worth per worker, which is comparable to the output per worker in the Stalingrad factory in the latter's second year of operation. In 1933, its second year, annual output per worker in the Kharkov factory was 11,544 rubles, which is comparable to that in the Stalingrad factory during the latter's fourth year of operation.

Labor productivity in an entire branch of industry is affected by the number of its component enterprises which began operation within a given period.

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p. 50. The following table shows the annual output per worker in Soviet ferrous metallurgy during the second Five-Year Plan (in tons):

	<u>Iron smelted per worker in blast furnaces</u>		<u>Steel smelted per worker in open hearth furnaces</u>	
	<u>1933</u>	<u>1937</u>	<u>1933</u>	<u>1937</u>
USSR	281.9	801.2	145.2	400.0
Magnitogorsk	571.4	2,140.6	364.1	967.1
Kuznets	461.2	1,817.9	304.9	693.9
Makeevka ("Kirov")	624.2	1,753.2	170.2	585.3

In ferrous metallurgy the productivity of workers in blast furnaces was directly proportional to the capacity of the furnaces, while in open-hearth furnaces, labor productivity was directly proportional to the area of the hearths. The close connection between the volume of a blast furnace and the expenditure of labor required to produce a ton of pig iron is shown in the following table:

	<u>Average volume of furnace (cu. m.)</u>	<u>Man-hours to produce 1 ton iron in 1939</u>
Magnitogorsk	1,177	0.80
Kuznets	992	0.98
Makeevka ("Kirov")	915	1.08
Stalin	567	1.52

The largest blast and open-hearth furnaces were in the new and rebuilt plants where new techniques and mechanization had been introduced

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to the fullest degree. Consequently labor productivity in such plants was well above the average for ferrous metallurgy in general.

p. 51. Annual productivity per worker, in unadjusted prices, in 1938 compared with that of 1913 as follows (1913 = 100): machine building 516, ferrous metallurgy 373, chemical industry 311, petroleum extraction 797, coal 251, cotton 332, woodworking 213, textiles 236, leather 255, printing 275, and food industry 352.

p. 53. In comparing labor productivity in the USSR with that in the US, it should be remembered that unemployment has been completely eliminated in the USSR, and that production represents the output of the truly average worker! In the US, where there is mass unemployment, production represents the output of the most skilled, the steadiest, and the most healthy workers.

Lowering of costs has occurred primarily in cases where the increase in labor productivity has outstripped the increase in wages. For example, labor productivity in the machine-building industry increased 63.8% during the first Five-Year Plan, average wages increased 53.8%, and costs fell 29%. As the result of lowered costs, the accumulation within the industry in this period amounted to 1 billion rubles. In the petroleum and printing industries, labor productivity increased faster than wages, and costs dropped for the entire period of the first

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increased faster than labor productivity, and costs increased for the period.

p. 55. In the automobile and tractor industry, the consumption of metal per 15-~~horse~~power tractor was cut from 3.6 tons in 1932 to 1.6 tons in 1937, and per automobile from 3.6 tons in 1932 to 2.3 tons in 1938. As a result of the technical improvement of ferrous metallurgy, the consumption of coke and iron has been steadily lowered, so that one ton of pig iron and other metal makes one ton of steel.

p. 58. The gross production of large-scale industry, in unadjusted prices, in Russia between 1915 and 1917 was worth 33 billion rubles, while in the USSR between 1942 and 1944 it was worth 361 billion.

p. 59. In industry alone, 31,850 enterprises were destroyed during the war and occupation. During the war alone, the following installations were built and put into operation: 24 blast furnaces, 128 open-hearth furnaces and 70 electric furnaces, and 56 rolling mills.

p. 60. During the first 2 years of World War II, the average number of hours worked per worker per month increased 22%, and hourly output per worker increased 7%.

The greatest increase in labor productivity throughout Soviet industry took place during the first 2 years of the All-Union Socialist Competition (1942-44), when industrial labor productivity rose 19 percent in 1942 and

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in 1943 was 7% above the 1942 level. The greatest increase occurred in war industry and in machine-building, where output per worker rose 31% in 1942 and in 1943 was 11% above the 1942 level.

Thus the number of man-hours required to build an IL-4 aircraft decreased from 20,000 in 1941 to 12,500 in 1943. The number required to build a 152-millimeter howitzer decreased from 4,500 in 1941 to 2,400 in 1943. The number required to build a T-34 tank decreased from 4,500 in 1941 to 2,400 in 1943. The number required to build a T-34 tank decreased from 8,000 in 1941 to 3,700 in 1943.

p. 64. The postwar Five-Year Plan (1946-50) called for a total volume of industrial production in the USSR of 205 billion rubles' worth (in 1926/27 prices) as compared with 138.5 billion in 1940. Like the prewar Plans, it called for a more rapid development of capital-goods than consumers'-goods production.

An increase in labor productivity of 36% for industry and 40% for building, as compared with the prewar level, was set for 1950. A higher rate of increase was prescribed for the machine-building industry than for industry in general: 54% for machine-tool building, 45% for automobile manufacture, 52% for machine-building in general, and 200% for transport-machine building.

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During the postwar Plan, a 1% increase in labor productivity meant 1,385 million rubles' worth of additional industrial production. A reduction of 17% in costs of industrial production in comparison with 1945, to be accompanied by increased quality, was called for by the Plan.

The Plan pointed out the following methods for increasing labor productivity: full utilization of the 8-hour working day; universal mechanization of industry; further electrification; and intensification of production processes.

p. 66. Gross production in Soviet industry increased as follows during the postwar Plan (in % of the preceding year): 20% in 1946, 22% in 1947, and 27% in 1948. In 1948 the prewar level of industrial output was surpassed by 18%.

About 4,000 state industrial enterprises were built and put into operation during the first 3 years of the Plan. In 1947, 4.2 million more blue- and white-collar workers were employed in the national economy than in 1946, and 2 million more in 1948, which meant an increase of 10% over the 1940 level.

During the first year of the postwar Plan, only certain branches of industry showed an increase in labor productivity. The conversion from defense to civilian production meant a reduction in labor productivity

in many enterprises. For example, the labor cost of producing farm

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machinery was much higher than prewar, while individual branches of the machine-building industry increased their labor productivity. In ferrous metallurgy and the coal industry, labor productivity in 1946 was greater than during the preceding year, but the labor-productivity plan was not fulfilled. In 1947, however, industrial labor productivity was 13% above the level of 1946. In 1948 it was 15% above the 1947 figure and had exceeded the prewar level. The plan for 1949 called for an increase over 1948 of 14% in industry and 12% in building.

The machine-building industry showed a greater increase in labor productivity than industry in general.

p. 68. The following table shows how labor costs were lowered because of new techniques and increased labor productivity in the machine tools industry.

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(in norm-hours)

	<u>1 Jan 47</u>	<u>1 Jul 47</u>	<u>1 Jan 48</u>	<u>% reduction of labor costs in 1 year</u>
"1D20M" screw-cutting lathe ("Krasnyy Proletariy" Factory)	636	500	450	41
"6B82" horizontal milling machine (GZFS)	1,557.4	1,100	1,000	55
Gear-cutting machine ("Komsomolets" Factory)	3,127	2,350	2,100	53

In the "Kaganovich" First State Bearings Factory, the labor cost of finished bearings in 1948 averaged 22.3% less than in 1947. Of this saving, 40% resulted from improved techniques, 13.4% from mechanization, 41.2% from improved organization of labor and production, and 5.4% from modernization of equipment or replacement by more productive equipment.

A few figures for the textile industry - p. 71.7

The following table shows how profits increased in the USSR (in millions of rubles):

	<u>1948</u>	<u>1949</u>	<u>Increase</u>	<u>%</u>
Profits of state enterprises and economic organizations	39,259	69,566	30,307	77.2
Industry	22,718	41,387	18,669	82.0

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Berri, L. Spetsializatsiya i Kooperirovaniye v Promyshlennosti SSSR.
Moscow, 1946.

p. 53. The following table shows the assortment of certain articles
at the beginning of the third Five-Year Plan, just before the outbreak
of World War II (in number of types):

<u>Item</u>	<u>Available Assortment in USSR</u>	<u>Necessary assortment (prewar)</u>	<u>Assortment in capitalist industries</u>
Metalworking lathes (1940)	500	800-1,000	4,000-5,000
Forging and pressing equipment (1940)	300	1,250	3,000
Adjustable calipers (smooth and threaded) (1938)	267	--	650 (US)
Micrometers	64	--	250 (US)
Indicators	6	--	200 (US)
Roller bearings (1939)	1,000	2,500-3,000	12,000
Technological equipment for the food industry (1940)	925	1,450	Several times as many
Rollod products (1937)	1,132	--	11,348 (Central Europe)

In 1932, a total of 40 types of machine tools for lathes were in
production in the USSR, as compared with over 300 in 1938, and over 500
in 1940, on the eve of World War II. However, the 18th session of the
Communist Party decided that 800 types were necessary.

p. 55. During the fourth Five-Year Plan, Soviet motor vehicle factories
devoted themselves to specialized production, as follows:

"Stalin" Auto Factory in Moscow: (a) ZIS-150 trucks (3.5 tons);
(b) ZIS-110 luxurious 7-passenger automobiles,

"Molotov" Auto Factory in Gorki: (a) GAZ-51 trucks (2.5 tons);

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"Pobeda" 5-passenger, economical, light and comfortable cars; (d) GAZ-67 automobiles.

Yaroslavl Auto Factory: YaAZ-200 trucks (5-7 tons, Diesel; 7-ton for hard-surfaced roads).

Ukrainian Auto Factory (Dnepropetrovsk): ZIS-150 trucks (3.5 tons).

Belcrussian Auto Factory: YaAZ-200 heavy vehicles (5-7 tons).

Moscow Factory: "Moskvich" automobiles.

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